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# (54) Tractor implement hitch control system

(57) A tractor implement hitch control system is selectively settable by the operator to operate in "draft control mode", "position control mode" or "intermix mode" in which a combination of signals from the draft force and the position sensing units is used. Electric signals are received from sensing units 25, 33 indicative of draft force on and postion of the hitch respectively.

When the system is operating in the intermix mode a number of discrete intermix ratios (D1, D2) are available which can be alternatively and predictably selected by the operator. In a preferred form of the invention a common control member (36) selects either pure position control (P), or pure draft control (D3), or one or more predetermined and discrete intermix ratios (D1, D2). This control member (36) can also be used to switch the system off and to select the transport position (T) of the hitch.

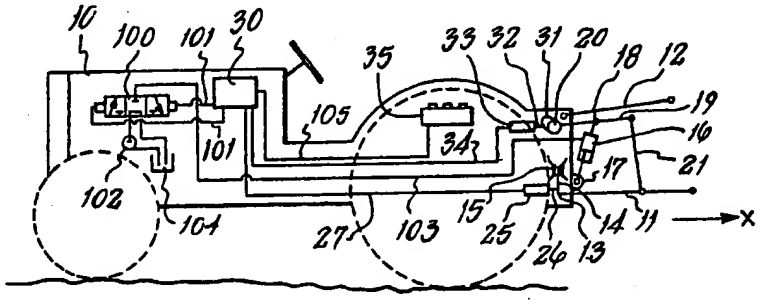


FIG.1

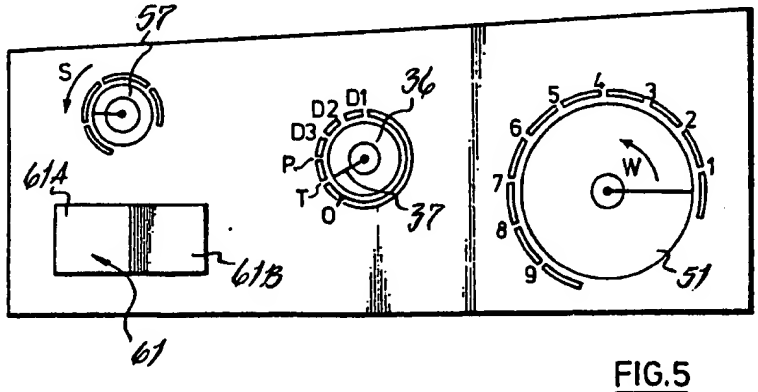


FIG.5

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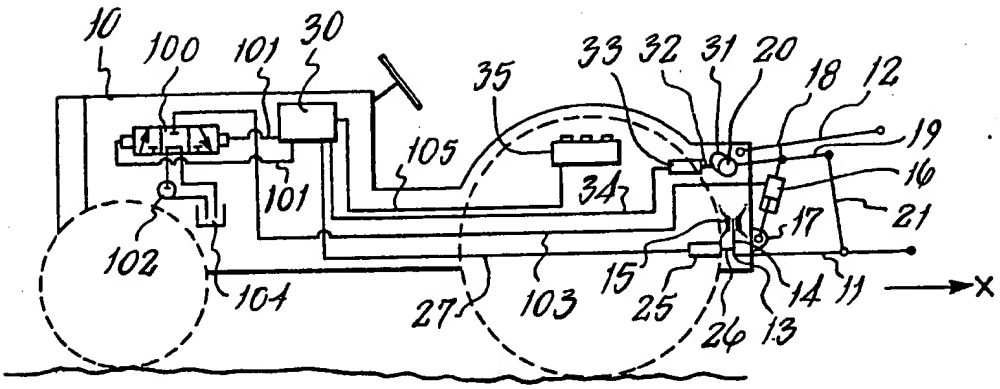
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100
101
30
35
33
32
31
20
18
12
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16
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105
101
34
17
102
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27
103
15
25
26
13
14
11
X

FIG.1

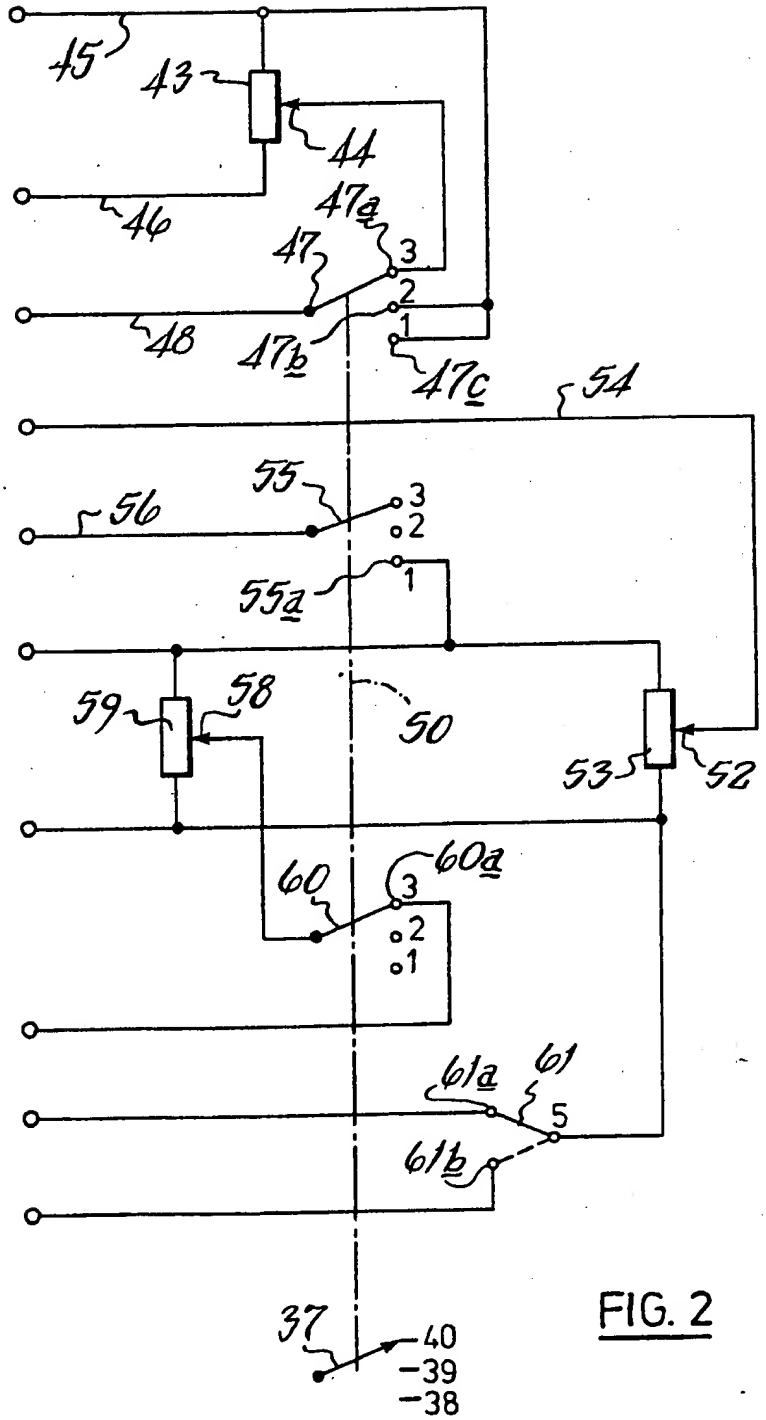

45
43
44
46
47a
47
3
2
48
47b
1
47c
54
55
56
3
2
55a
1
59
58
50
53
52
60
60a
3
2
1
61a
61
5
61b
37
40
39
38

FIG. 2

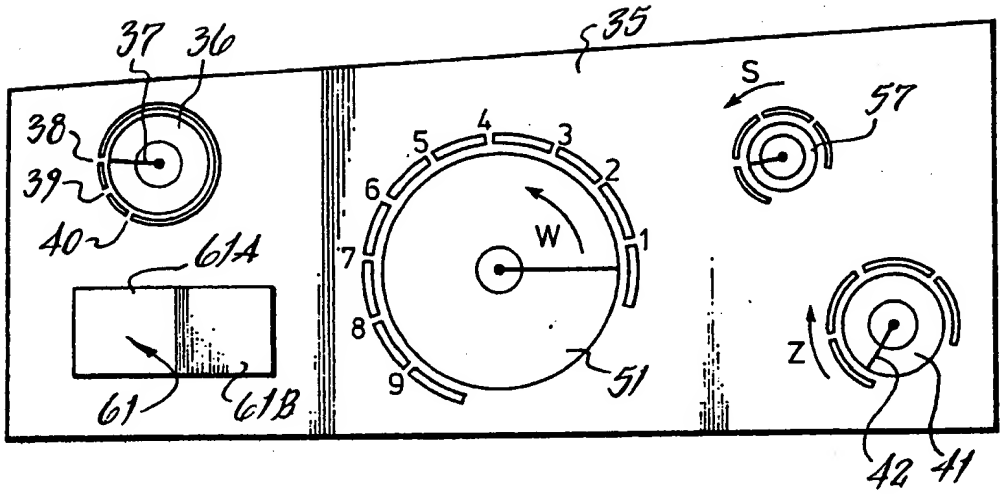

37
36
35
38
39
40
61A
61
61B
5
4
3
2
6
1
7
8
9
W
51
S
57
Z
42
41

FIG. 3

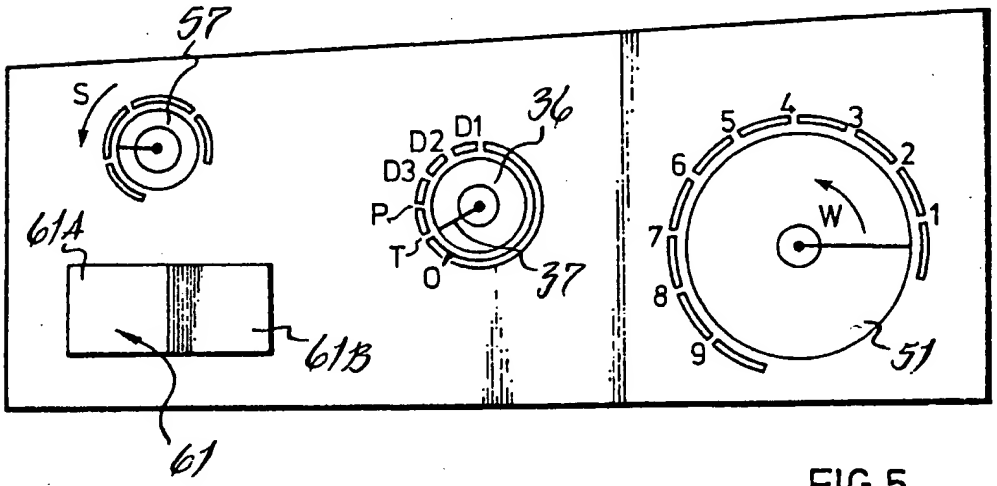
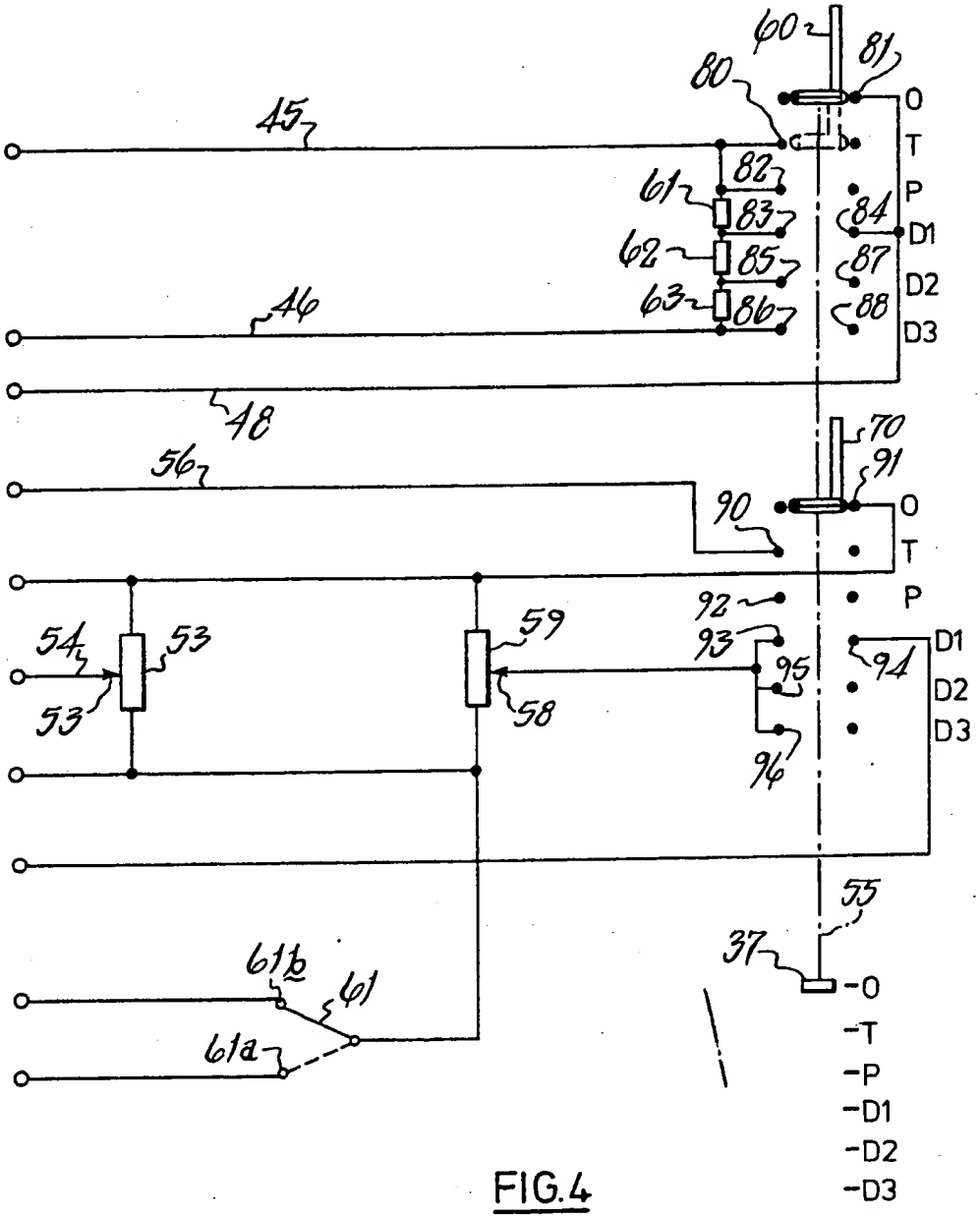

57
S
61A
61B
61
D2
D1
36
D3
P
T
O
37
5
4
3
2
6
1
7
8
9
W
51

FIG. 5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81
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45
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83
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86
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70
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56
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92
93
95
94
54
53
59
58
96
55
37
61b
61
61a
O
T
P
D1
D2
D3
-O
-T
-P
-D1
-D2
-D3

FIG.4

SPECIFICATION

**Tra tor implement hitch control system**

This invention relates to tractor implement hitch control systems (hereinafter referred to as being "of the kind specified") which are arranged to receive electrical input signals from sensing units indicative of the actual draft forces imposed on the hitch and the actual position of the hitch relative to the tractor and compare these input signals with a nominal value signal set by the operator and indicative of the required draft force or hitch position to produce an error signal which is used to control the height of the hitch so that the hitch is caused to operate substantially as set by the nominal value signal, the system being selectively settable by the operator to control the height of the hitch in any one of three modes, a 'draft control' mode using a draft force input signal only, a 'position' mode using a position input signal only, and an 'intermix' mode using an input signal derived from an intermix of the signals from the draft force and position sensing units.

It is known in a hitch control system of the kind specified to have a first control member which selects the 'draft' or 'position' operating mode, a second control member which selects the 'intermix' mode and a full range of intermix ratios variable in a stepless or continuous manner between the extremes of 100% draft control and 100% position control, and a third control member which sets the nominal value signal.

Experience has shown that operators frequently encounter difficulty in using a system of the kind referred to in the preceding paragraph in the 'intermix' mode. The difficulty arises as follows:

If the operator is operating the control system with a plough in 'draft control' and, due for example to variations in soil condition, decides to use the 'intermix' mode, the very act of moving the second control member to switch in a degree of intermix produces a variation in the operating depth of the plough which will necessitate an adjustment of nominal value signal using the third control member. It frequently occurs that the initial intermix setting selected using the second control member, and the necessary adjustment of the nominal value signal using the third control member, does not result in the plough attaining either the required depth or the required stability of depth in the varying soil conditions being experienced. Thus the operat r is forced to vary either th intermix setting or the nominal valu signal in an att mpt t attain the required plough performance. As will b appreciated if, after s v ral such adjustments of th second and third control member (as i not uncommon in this situati n) the desired plough performance has been achieved, the operator is frequenctly in a c nfused state and has lost track in his mind of adjustments which he has made and their consequent effects, so that he is without any meaningful datum against which to decide what further adjustments are required. This often leads to excessive time being required to achieve the correct setting-up of the plough in difficult soil conditions.

It is an object of the present invention to simplify the control by the operator of a control system of the kind specified to at least partially mitigate the above described difficulty.

Thus, according the present invention in a control system of the kind specified, when operating in the intermix mode, a number of predetermined and discrete intermix ratios are available which can be alternatively selected by the operator.

For example, the operator can select to provide an input signal constituted 37.5% from the draft signal 62.5% from the position signal or alternatively 69% from the draft signal and 31% from the position signal. Thus it will be understood that the intermix ratio is not continuous variable as in the known arrangements.

In a preferred arrangement in accordance with the invention the selection of the mode of operation of the system and the operative intermix ratio is under the control of a common control member. That is the first and second control members of the known systems are combined.

Typically this common control member will have positions for the selection of pure position control and pure draft control and one or more intermix positions for the selection of predetermined and discrete intermix ratios. The common control member may also have a number of other positions, for example, an 'off' position in which the system is rendered inoperative, a position to select the 'transport' position of the hitch and a 'float' position in which the hitch is free to float when in work to find its own height.

Conveniently, the intermix positions of the common control member are located in-between the pure draft control and pure position control positions with the intermix ratio(s) with the smallest proportion of position signal nearest to the pure draft control position.

As will be appreciated, a control system is accordance with the present invention is significantly easier for the operator to set-up in, for example, the varying soil conditions discussed above. Thus when ploughing, if the system has two or three predetermined discrete intermix ratios, the operator, dependent on his assessm nt of th soil conditions, might select say th intermix rati which has the smallest proportion of position signal and he would then by adjustment of th datum signal try to achieve the desired op rating condition of the

plough. If this were to prove unobtainable with the selected intermix ratio the operator would select the next ratio with a higher 'position' proportion and again repeat his adjustment of the datum signal. At all times the operator will be clear as to the intermix ratio in use and he will be able to easily and predictably switch between the discrete ratios available.

The present invention will now be described, by way of example only, with reference to the accompanying drawings in which:–

*Figure 1* is a diagrammatic view of a tractor fitted with a hitch control system of the kind specified;

*Figure 2* is a schematic diagram of part of the circuit of a known form of control system of the kind specified;

*Figure 3* is a diagrammatic representation of the control panel for the system of Fig. 2;

*Figure 4* is a schematic diagram of a part (corresponding to Fig. 2) of the circuit of a control system in accordance with the present invention, and

*Figure 5* is a diagrammatic representation of the contol panel for the system of Fig. 4.

Fig. 1 shows a tractor 10 provided with a rear implement hitch in the form of a pair of lower draft links 11 and a top link 12. The draft links 11 are pivotally mounted at 13 on leaf springs 14 which are carried by a fixed part 15 of the rear tractor housing. The draft links can be raised and lowered in the normal manner by a pair of piston and cylinder assemblies 16 which are pivotted at 17 on the tractor housing and connected at 18 with a pair of conventional upper arms 19 supported on the ends of the usual ccross shaft 20. The upper arms 19 are connected by drop arms 21 with the draft links 11. Thus as the draft links 1 are raised and lowered by the piston and cylinder assemblies 16 the cross shaft 20 rotates in its supports on the tractor housing in the usual manner.

The draft forces X applied to the draft links 11 are measured by a pair of variable inductance draft force sensing units 25 whose probes 26 contact the leaf springs 14. Thus as the leaf springs 14 deflect under a draft load this deflection is measured by the sensing unit and each sensing unit produces an electrical signal which is proportional to the draft force being applied to the associated draft link 11. These draft force signals are relayed via lines 27 to a control system indicated diagrammatically by box 30 in Fig. 1.

The cross shaft 20 carries a cam 31 which is contacted by the probe 32 of a hitch "position" sensing unit 33 which is also of the variable inductance type. Thus the changes in the position of the draft links 11 relative to the tractor result in rotation of the cross shaft 20 and thus displacement of the sensing probe 32 of sensing unit 33 to produce a "position" signal indicitive of the actual position of the draft links 11. This position signal is relayed to the control system 30 via line 34.

The control system 30 is controlled by the tractor operator using a control panel or console 35 which is connected with the system 30 via lines 105 Further details of the control panel 35 will be given below.

Control system 30 produces signals which relayed to a solenoid operated valve 100 via lines 101. Value 100 controls the supply of pressurised fluid to piston and cylinder assemblies 16 from a pump 102 via line 103 and also controls the exhausting of fluid from the piston and cylinder assemblies 16 to a sump 104.

Fig. 3 shows the general layout of the controls of the control panel or console 35 while Fig. 2 shows schematically the basic circuitry for entering the control settings into the control system 30.

The control panel has a first control member in the form of a rotatable dial 36 whose setting datum is shown diagrammatically at 37 can be moved by the operator between a 'transport' position 38, a 'position control' position 39, and a 'draft' position 40. Further reference to the use of control 36 will be made below.

A second control member in the form of a rotatable dial 41 is provided to control the intermix ratio. With the dial datum 42 in the position shown in Fig. 3 and the datum 37 of dial 36 in the draft control position the hitch is arranged to operate under 100% draft control.

As the dial 41 is rotated in the direction Z of Fig. 3, a progressively increasing percentage of 'position' signal from sensing unit 33 is mixed with the draft force signals from sensing units 25. The intermixing of the 'draft' and 'position' signal is achieved by a rheostat 43 whose movable contact 44 is moved by rotation of dial 41. One end of rheostat 43 is provided with a signal derived from position sensing units 33 via line 45 and the other end of the rheostat 43 is provided with a signal derived from the draft force sensors 25 via a line 46. The intermixed draft and position signals are directed via the movable contact 44 and switch 47 to a line 48 which serves as an input line to a signal comparator (not shown) which forms part of the system.

As can be seen from Fig. 2 the switch 47 is connected with the datum 37 of dial 36 (shown by chain dotted line 50) so that the movable contract 44 of the rheostat 43 is only connected with line 48 when the dial 36 is in the 'draft control' position. In this condition switch contact 47*a* is in use. This ensures that the intermix facility is only available when the system is operating in the draft control mode.

As can be seen from Fig. 2 when the dial 36 is set in th 'position' control or 'transport' positions, switch contacts 47*b* and 47*c* are closed respectiv ly and the rheostat 43 is not operative so that line 48 receives simply the 'position' signal from line 45.

A third control in the form of a rotatable dial 51 is provided which is connected with the movable contact 52 of a rheostat 53. This dial is used to set a datum signal which is fed to the signal comparator via a line 54 and is indicitive of the required draft link position or draft force (movement in direction W increases depth). A further switch 55 is connected with the dial 36 and is arranged to have its contact 55*a* completed when the transport position is selected on dial 36 this provides a signal via line 56 which moves the draft links to the transport positions without affecting the setting on dial 51.

A further dial 57 is provided which is connected with the movable contact 58 of a rheostat 59. Dial 57 is used to adjust the sensitivity of the control system (movement in direction S increases the sensitivity) and a switch 60 connected with movable contact 58 ensures that the variable sensitivity feature is only available when the system is operating on draft control and contact 60*a* is closed.

The control panel also includes a two - position rocking type switch 61 which is used to provide a signal to achieve a fast raising of the draft links to the transport (by pressing end 61A) and lowering of the draft links to the working position set by dial 51 (by pressing end 61B). This switch is used, for example, to raise an implement to the transport position when turning on a headland and then to lower the implement into work on commencement of the working operation after making the turn. Contact 61*a* is arranged to be closed when end 61A of switch 61 is pressed to lift the hitch to the transport position and contact 61b is closed when end 61B is pressed to lower the implement to its selected working position.

As previously indicated, when using the control panel arrangement described above significant difficulty is experienced by the tractor operator, on occasions, in correctly setting-up the control system to operate in the intermix mode.

This difficulty is overcome by the simplification of the control panel provided by the present invention which is shown in Fig. 5, the associated control circuit of the present invention (corr sponding to Fig. 2) is shown schematically in Fig. 4. Components of Figs 4 & 5 having a corresponding function to equivalent compon nts in Figs 2 & 3 have been similarly numbered.

As can be seen fr m Fig. 5 the control dial 36 and 41 of Fig. 3 have been amalgamated into a single dial 36 in the control syst m of th pr sent inv ntion. Th dial 36 is connected, as shown at 55 in Fig. 4 with a m vable contact memb r 60 which is diagrammatically shown in Fig. 4 as being of L-shaped form. Contact memb r 60 combines the functions of contact 44 and switch 47 as described in relation to Fixture 2. In practice contact member 60 could be, for example, a rotary switch contact. The rheostat 43 of Fig. 2 is replaced by a series arrangement of resistances 61, 62, and 63.

Dial 36 is provided with an 'off' position designated O, a 'transport' position designated T, a 'position control' position designated P, and three 'draft control' positions designated D1, D2 and D3 respectively. These positions of dial 36 are reflected in corresponding positions of movable contact 60.

A second movable contact 70, which is again shown diagrammatically as being of L-shaped form but which could again in practice be the movable contact of a second rotary switch, is also connected with dial 36 as indicated at 55 and has contact positions corresponding to each of the positions of dial 36.

Thus considering the dial 36 in the 'off' position designated O both contact members 60 and 70 also occupy their O positions so that line 48 is disconnected from the position and draft signals of lines 45 & 46 and the transport signalling line 56 is broken.

If dial 36 is now moved to the transport position T and both contact members 60 & 70 occupy their transport positions it will be seen that contact member 70 bridges contacts 90 & 91 to provide the transport position signal to move the hitch to the required transport position. Contact member 60 also bridges contact 80 & 81 to provide a connection between the 'position' signal of line 45 and line 48.

If dial 36 is now moved to the 'position control' position P contact member 70 connects non-operative contact 92 with contact 91 thus cutting out the 'transport' signal and contact member 60 connects contact 82 with contact 81 to again provide a flow path for the position signals of line 45 to line 48. Thus the control system can operate in 'position control' with the signal in line 48 being compared with the required nominal value signal set on rheostat 53 and available at line 54.

If the dial 36 is now moved to the first draft control position designated D1 it will be seen that contact member 70 bridges contact 93 & 94 to bring into operation sensitivity control dial 57 and associated rheostat 59 and contact member 60 bridges contact 83 & 84 to bring into operation resistanc 61. Thus the s called 'draft control' position D1 is in fact a first intermix position in which a higher proportion of th signal passing along 48 to th comparitor is composed from th position

signal f lin 45 than the draft signal of line 46. For example, it is envisaged that in the position D1 62.5% of the signal in line 48 would be derived fr m line 45 and 37.5% from line 46.

If dial 36 is now moved to draft position D2, contact member 70 bridges contacts 95 and 94 to again switch in the sensitivity dial 57 and contact member 60 bridges contacts 85 & 87 to bring into play resistances 61 & 62 in controlling the proportion of 'position' signal present in line 48. Thus position D2 is a second intermix ratio in which, for example, 31% of the signal in line 48 would be derived from line 45 and 69% from line 46.

If the dial 36 is now moved to draft control position D3 contact member 70 bridges contacts 96 & 94 so that the sensitivity dial 57 is again operative and contact member 60 bridges contacts 86 & 88 thus effectively switching out the position signal of line 45 and ensuring that the signal passing along line 48 to the comparitor is 100% derived from line 46. Thus draft control position D3 is a true 100% draft control position.

It will be seen that the present invention thus provides a tractor implement hitch control system in which only predetermined and discrete intermix ratios are available and in which a single control member (dial 36) is used to select the transport, position control and draft control modes of operation as well as the operative intermix ratio when operating in the intermix mode. As explained above this greatly facilitates the setting-up of the system in certain difficult operating conditions.

CLAIMS

1. A tractor implement hitch control system of the kind in which, when operating in the intermix mode, a number of predetermined and discrete intermix ratios are available which can be alternatively and predictably selected by the operator.

2. A system according to claim 1 in which the selector of the mode of operation of the system and the operative intermix ratio is under the control of a common control member.

3. A system according to claim 2 in which the common member has positions for pure position control and pure draft control and one or more intermix positions for the selection of predetermined and discrete intermix ratios.

4. A system according to claim 3 in which the common control member also has an "off" positi n in which the system is rendered inoperative, a position to select the "transport" position of the hitch, and a "float" position in which the hitch is free t float when in work to find its own height.

5. A system according to claim 3 in which th int rmix positions of the common control member are locat d inb tw n the pur draft control and the pur position control positions with the int rmix ratio(s) with the smallest proportion of p sition.

6. A system according to any one of claims 1 to 5 in which the position and draft signals are connected to opposite ends of a series arrangement of discrete resistors and the desired discrete intermix ratio is achieved by taking the output intermixed signal from between a given pair of adjacent resistors of the series arrangement.

7. A tractor implement hitch control system of the kind specified constructed and arranged substantially as hereinbefore described with reference to and as shown in Figs. 1, 4 & 5 of the accompanying drawings.

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